DOCUMENT RESUME

ED 241 576 TM 840 110

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TITLE Measuring Academic Efficiency at the School Level.
PUB DATE [81]
NOTE 17p.
PUB TYPE Guides - Non-Classroom Use (055) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Classroom Observation Techniques; Elementary Secondary Education; *Evaluation Methods; *Mathematical Models; Measurement Techniques; Reliability; *School Effectiveness; *Time on Task
IDENTIFIERS *Academic Efficiency

ABSTRACT

In this paper, academic efficiency is operationally defined and a methodology for measuring it at the school level is described. Academic efficiency is defined as the extent to which a school utilizes its time for the academic development of all its students. The measure of academic efficiency must include three elements: time, students, and academic development. The metric used is the student-minute; one student-minute is a minute spent by one student. Assuming that academic engagement is the legitimate proxy of academic efficiency, the index of academic efficiency is the proportion of engaged student-minutes to total student-minutes. To calculate this index, six different types of data must be collected at the school level: total time available in school day, time scheduled for noninstructional activities, total enrollment, average number of students absent per day, average engagement rate, and average proportion of nonacademic instructional time per class. Procedures have been developed at the Mid-Continent Regional Educational Laboratory for sampling engagement rate and non-academic instructional time. (BW)

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MEASURING ACADEMIC EFFICIENCY AT THE SCHOOL LEVEL

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MEASURING ACADEMIC EFFICIENCY AT THE SCHOOL LEVEL

At the heart of institutional evaluation is the question, "How well are we accomplishing our goals with the resources available?" For institutions devoted to education the most salient goal is academic development—the extent to which students learn as a function of how the school operates. Recent studies (Fisher et al. 1978, Evertson 1980) have identified one variable that has a strong relationship with academic development and is within the control of educational institutions. That variable is the engaged time of students. We have long known that variables such as socio-economic status, native intelligence and home environment have an effect on achievement but these are totally out of the control of educational institutions. The extent to which students are engaged, however, is a function of school related variables and, consequently, qualifies as a variable around which the measurement of a school's efficiency can be built.

In this paper we will operationally define academic efficiency and describe a methodology for measuring it at the school level. Academic efficiency is here defined as "the extent to which a school utilizes its time for the academic development of all its students." According to this definition the measure of academic efficiency must include three elements: 1) time, 2) students, and 3) academic development. Based on the research, we assume that "academic engagement" is a legitimate proxy measure of "academic development." To measure academic efficiency we must create a metric, then, which can

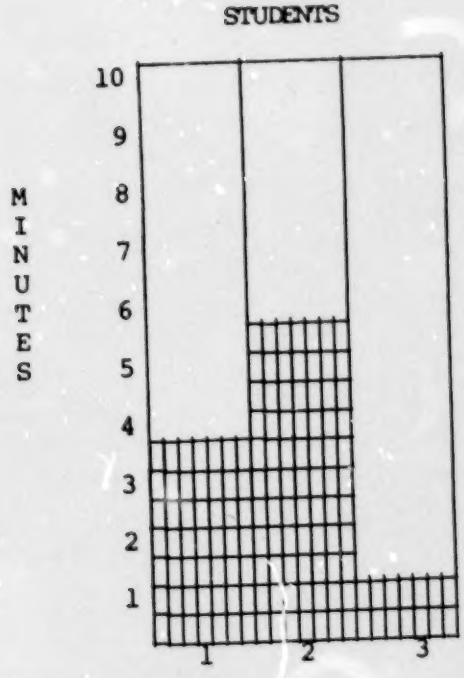
incorporate time, students and academic engagement. That metric is student-minutes. One student-minute is a minute spent by one student; in any one minute during a school day there are as many student-minutes as there are students. The total number of student-minutes in a school day is the number of students multiplied by the number of minutes in the school day. Thus, a school which has a 400 minute day and 100 students would have 40,000 total student-minutes available to it.

Our index of academic efficiency is the proportion of engaged student-minutes to total student-minutes. Using a trivial example to illustrate the concept assume that we have a school with three students and a ten minute day. If student #1 spends 3 minutes engaged in academic activities, student #2 spends 5 minutes and student #3 spends 1 minute, then the total number of student-minutes in which students are engaged in academic activity is nine (3+5+1) and the academic efficiency of the school is 9/30 or .30. This is depicted in Figure 1.

Figure 1 about here.

Of course in the "real world" each student cannot be monitored every minute of the day. Hence, data gathering techniques must involve estimates of engaged student-minutes and various quantities which will yield a measure of academic efficiency and a number of other very useful indices.

Figure 1



DATA NECESSARY TO CALCULATE

ACADEMIC EFFICIENCY

To calculate an index of academic efficiency six different types of data must be collected at the school level. We consider each briefly.

1) Total time available in school day: This quantity is the time in minutes from the beginning of the school day to the end as measured by the bell initiating the day and the bell ending it.

2) Time scheduled for noninstructional activities: This quantity is the total minutes in the school day in which instruction is not scheduled. Noninstructional activities include lunch, recess, transition time between classes, home room, etc. To illustrate, assume that a school schedules the following non-instructional activities:

lunch	30 minutes
recess	30 minutes
transition time between classes	30 minutes
home room	15 minutes
TOTAL	105 minutes

The total of 105 minutes would be considered the time scheduled for noninstructional activities.

3) Total enrollment: The figure that best represents a school's enrollment throughout the year is considered its total enrollment figure. If a school has a wide variance in enrollment, an average should be taken.

4) Average number of students absent per day: This quantity is the average number of students absent on any given day. Most schools have this information readily

available. The best procedure is to study the absentee records over an extended period of time and take an average of the number of absentees.

5) Average engagement rate: Engaged rate is the measure of academic involvement of students. In much of the current literature academic involvement has been operationally defined as the extent to which a student is involved in the assigned task at any one point in time. In most studies some "time sampling" procedure is used in which the number of students who appear to be engaged in the assigned task is noted at various intervals. The average number of students engaged divided by the number of students observed is then taken to be the engagement rate of the class observed.

To use this measure in the calculation of academic efficiency it is recommended that a number of representative classes be sampled and the engaged rate calculated for each class. The average of this is then considered a representative estimate of the total school engagement rate.

6) Average proportion of nonacademic instructional time per class: This is the average proportion of class time which is not spent on academic activity. In every class some time is spent performing such activities as passing out papers, collecting papers, disciplining, etc. The quantity necessary to calculate academic efficiency is the average proportion of time spent on such activities in each class. The procedure for obtaining this quantity is to take a

representative sample of classes and record the amount of time spent in the following activities:

1) Beginning managerial activities
2) Transition time (passing out books, collecting books)
3) Teacher giving or explaining an assignment
4) Teacher disciplining (whole class disturbed)
5) Teacher working with one or two students--others wait
6) Ending managerial activities
7) Social activities
8) Outside interruptions

The total amount of time spent on these activities divided by the total amount of time the classes were observed is the average proportion of non-academic instructional time. For example suppose that three classes were sampled and the following times recorded:

	Class #1	Class #2	Class #3
1) Beginning managerial activity	3.5 min	4.5 min	4.1 min
2) Transition time	2.5 min	2.1 min	3.2 min
3) Teacher giving & explaining assignment	1.2 min	2.5 min	4.2 min
4) Teacher disciplining	1.1 min		1.3 min
5) Teacher working with one student-others wait		1.4 min	

6)	Ending managerial activity	2.3 min	2.3 min	2.0 min
7)	Social activity		1.5 min	2.5 min
8)	Outside interruption	2.4 min		4.2 min
	Totals	13.0 min	14.3 min	21.5 min
	Total time observed	50.0 min	40.0 min	55.0 min

The totals for all classes 48.8 (13.0+14.3+21.5) divided by the totals of the times observed 145 (50+40+55) would be the desired quantity: 48.8/145 = .337.

Procedures have been developed at the Mid-continent Regional Educational Laboratory for sampling engagement rate and non-academic instructional time. We have found that with a minimum amount of training (one hour) previously untrained observers can collect data with relatively high reliability (.85).

CALCULATING ACADEMIC EFFICIENCY

Once data have been gathered, pertinent to the six quantities described above, the calculation of academic efficiency and other related indices is a fairly straightforward process. To illustrate, assume that a school has collected the following information:

Total Time available in school day		400 min
Time Scheduled for noninstructural activity		
-lunch	30 min	
-home room	15 min	
-transition time between classes	30 min	

-recess	30 min	
-other	30 min	
TOTAL	135 min	
Total Enrollment		1205
Average number of students absent per day		98
Average engagement rate		.720
Average proportion of non-academic instructural time		.170

This information should be recorded in the worksheet presented in Figure 2.

FIGURE 2.

ACADEMIC EFFICIENCY WORKSHEET

I. Scheduling

A. Total time available in school day _____400_____

B. Time scheduled (min.) for instructional activity:

a. lunch period	30
b. homeroom	15
c. between classes	30
d. recess	30
e. other	30
f. Total (a+b+c+d+e)	135

C. Proportion of time scheduled outside of class (f/A) = _____

D. Proportion of time scheduled for class = 1.00-C = _____

II. Absenteeism

E. Total students enrolled _____1205_____

F. Average number of students absent per day _____98_____

G. Proportion of absenteeism (F/E) _____

H. Proportion of students attending (1.00-G) _____

III. Nonacademic in-class activity

I. Average proportion of nonacademic instructional time .170

J. Proportion of school day lost to in-class nonacademic activity (IxD) _____

K. Remainder of School Day (D-J) _____

IV. Engagement

L. Average engagement rate: .720

M. Proportion of school day engaged (LxK) = _____

V. Inattentiveness

N. Average proportion of time lost in class to inattentiveness (1.00 - L) = _____

O. Proportion of school day lost to inattentiveness (N x K) _____

This worksheet is then used to calculate various intermediate quantities. We will consider each briefly.

C. Proportion of time scheduled outside of class: divide the quantity in F by the quantity A: 135/400 = .338.

D. Proportion of time scheduled outside of class: subtract the quantity C from 1.00: 1.00-.338 = .662.

G. Proportion of absenteeism: divide the quantity F by E: 98/1205 = .081.

H. Proportion of students attending: subtract the quantity G from 1.00: 1.00-.081 = .919.

J. Proportion of school day lost to in-class non-academic activity: multiply the quantity I times D: .170 x .662 = .113.

K. Remainder of school days: subtract the quantity J from D: .662 -.113 = .549.

M. Proportion of school day engaged: multiply the quantity L times K: .720 x .549 = .395.

N. Average proportion of time lost in class to inattentiveness: subtract the quantity L from 1.00: 1.00-.720 = .28.

O. Proportion of school day lost to inattentiveness: multiply the quantity N times K: .280 x .549 = .154.

These calculations can be checked for accuracy by adding C, J, M and O. Because they all represent proportions of time devoted to various activities they should total 1.00 (.338 + .113 + .395 + .154 = 1.00).

When completed the Academic Efficiency Worksheet would resemble that reported in Figure 3.

FIGURE 3.

ACADEMIC EFFICIENCY WORKSHEET

I. Scheduling

A.	Total time available in school day		400
B.	Time scheduled (min.) for instructional activity:		
	a. lunch period	30	
	b. homeroom	15	
	c. between classes	30	
	d. recess	30	
	e. other	30	
	f. Total (a+b+c+d+e)	135	
C.	Proportion of time scheduled outside of class (f/A) = (135/400=)		.338
D.	Proportion of time scheduled for class = 1.00-C = (1.00-.338)		.662

II.	Absenteeism	
	E. Total students enrolled	1205
	F. Average number of students absent per day	98
	G. Proportion of absenteeism (F/E)= (98/1205)	.081
	H. Proportion of students attending (1.00-G)=(1.00-.081=)	.919
III.	Nonacademic in-class activity	
	I. Average proportion of nonacademic instructional time	.170
	J. Proportion of school day lost to in-class nonacademic activity (IxD,=(.17x.662)=	.113
	K. Remainder of School Day (D-J)= (.662-.113=)	.549
IV.	Engagement	
	L. Average engagement rate:	.720
	M. Proportion of school day engaged (LxK) = (.72x.549=)	.395
V.	Inattentiveness	
	N. Average proportion of time lost in class to inattentiveness (1.00 - L) = (1.00-.72=)	.280
	O. Proportion of school day lost to inattentiveness (N x K) = (.28x.549=)	.154

The worksheet now contains all the information necessary to calculate academic efficiency. Recall that our definition of academic efficiency was the proportion of engaged student-minutes to total student-minutes. This can be calculated by multiplying the quantity M by the quantity H. M is the proportion of the school day in which students are engaged; H is the proportion of students attending. Hence, the product of these two is the proportion of engaged

student-minutes to total student-minutes which is our definition of academic efficiency. Using our sample data...

Academic Efficiency = (M x H) = .395 x .919 = .363

Along with academic efficiency we can use the information in the worksheet to calculate four other quantities pertinent to a school's use of student-minutes. They are:

Efficiency Loss due to Scheduling (C x H) = (.338 x .919) =	.311
Efficiency Loss due to Non-academic Activity in Class (J x H) = (.113 x .919) =	.104
Efficiency Loss due to Student Inattentiveness (O x H) = (.154 x .919) =	.142
Efficiency Loss due to Absenteeism = G =	.081

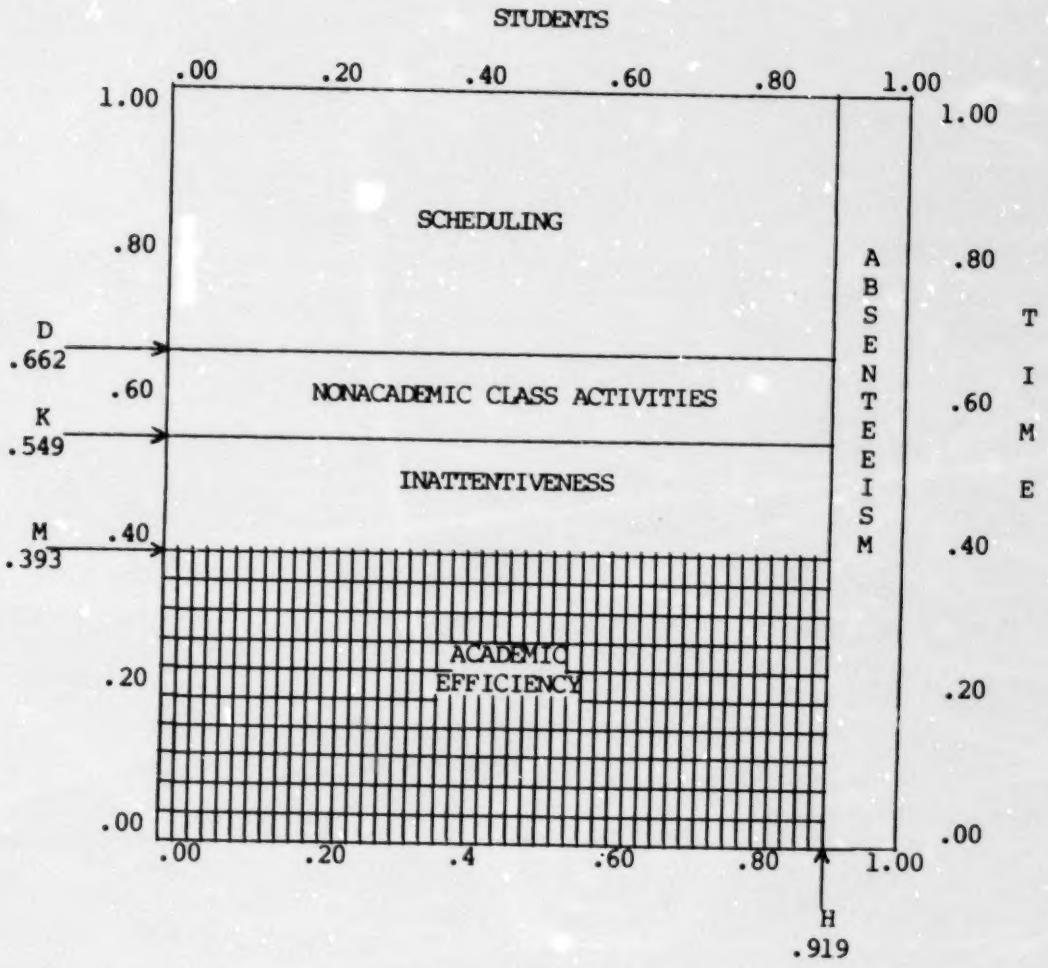
The four indices above along with the index of academic efficiency can be used as a diagnostic tool by schools. Together they always total 1.00 (.363 + .311 + .104 + .142 + .081 = 1.00) within rounding error. What we have done is transform all data about students and time into proportions. Hence, we can represent the total student-minutes in a day as a square the area of which is 1.00. The five indices above can then be represented as partitions of that overall area. Using our sample data this is illustrated in Figure 4.

Figure 4 about here.

Schools find such a visual representation highly useful; with it they can pinpoint areas that are the most detrimental to their academic efficiency.

FIGURE 4

ACADEMIC EFFICIENCY GRID



RELIABILITY AND VALIDITY OF THE INDICES

The reliability of the five indices presented above has already been addressed in our discussion of data gathering techniques for engagement rate and proportion of non-academic instructional time. These are the only two quantitives that would be subject to variation due to rater error. Again, the estimate of reliability for these two quantities is quite high even with minimal training. In a sense, the validity of the indices has already been established by those studies which have determined the relationship engaged time has with student achievement after prior achievement has been partialled out. Significant proportions of residual variances accounted for by engaged time range from .03 to .26 (Borg, 1980). Of course, the sampling unit for a validity study of the academic efficiency indices is the school, not the student. For example, an overall achievement score for a school must be used as the dependent measure. The Mid-continent Regional Educational Laboratory is currently collecting data for such a study. However, we feel there is a substantial enough research base to warrant the use of the indices described above as diagnostic tools at the school level.

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